CLAIMS

What is claimed is:

1. A method for controlling brake-application energy in a vehicle combination including a tractor vehicle equipped with an electronic braking system and a trailer vehicle, the tractor vehicle having at least one front axle and at least one rear axle, the trailer vehicle having at least one trailer axle, the method comprising the steps of:

determining, during braking of said vehicle combination, a set deceleration value,

measuring, during braking of said vehicle combination, an actual deceleration value,

comparing said set deceleration value with said actual deceleration value,

determining a brake-application energy reference value from the comparison of said set deceleration value with said actual deceleration value,

determining a brake-application energy level for said tractor vehicle and a brake-application energy level for said trailer vehicle,

determining an axle-load ratio for said tractor vehicle,

providing sets of performance characteristics in said electronic braking system representing the dependencies of said brake-application energy level for said tractor vehicle and said brake-application energy level for said trailer vehicle on at least one of said brake-application energy reference value and said axle-load ratio,

calculating a set brake-application energy value for said tractor vehicle based on said set deceleration value, a value that is a function of said brake-application

energy reference value, and said brake-application energy level for said tractor vehicle, in accordance with said sets of performance characteristics, and

calculating a set brake-application energy value for said trailer vehicle based on said set deceleration value, said value that is a function of said brake-application energy reference value, and said brake-application energy level for said trailer vehicle, in accordance with said sets of performance characteristics.

2. The method according to claim 1, further comprising the step of distributing brake-application energy to said tractor vehicle and said trailer vehicle based on said set brake-application energy value for said tractor vehicle and said set brake-application energy value for said trailer vehicle.

3. The method according to claim 2, wherein said sets of performance characteristics, said brake-application energy level for said tractor vehicle and said brake-application energy level for said trailer vehicle are associated with predetermined influencing factors, and wherein said step of distributing brake-application energy is effected in a manner associated with a selected one of said influencing factors.

4. The method according to claim 3, wherein said predetermined influencing factors range from a minimum value of 0 percent to a maximum value of 100 percent.

5. The method according to claim 4, wherein, when said selected one of said influencing factors is said maximum value, said brake-application energy level for said tractor vehicle is based on only said axle-load ratio and said brake-application energy level for said trailer vehicle is based on said axle-load ratio and on

said brake-application energy reference value.

6. The method according to claim 4, wherein, when said selected one of said influencing factors is said minimum value, said brake-application energy level for said tractor vehicle and said brake-application energy level for said trailer vehicle are based on only said brake-application energy reference value.

7. The method according to claim 3, wherein each set of said sets of performance characteristics is graphically representable by a grouping of parallel straight lines associated with different ones of said axle-load ratio, end points of said lines forming a parallelogram defining a working range of brake-application energy control, different ones of said groupings of parallel straight lines having different slopes associated with different ones of said influencing factors.

8. The method according to claim 7, wherein said sets of performance characteristics are obtained by rotating lines corresponding to different ones of said axle-load ratio around points of intersection of said lines corresponding to different ones of said axle-load ratio with a diagonal of said parallelogram, said lines corresponding to different ones of said axle-load ratio being rotatable from a zero slope associated with said maximum value of said influencing factor to a slope of said diagonal of said parallelogram associated with said minimum value of said influencing factor.

9. The method according to claim 1, wherein, using said sets of performance characteristics, said brake-application energy level for said tractor vehicle and said brake-application energy level for said trailer vehicle are determined from said brake-application energy reference value during braking of said vehicle combination.

10. The method according to claim 1, further comprising the step of storing said brake-application energy reference value as a non-current brake-application energy reference value after a braking of said vehicle combination.

11. The method according to claim 10, wherein said value that is a function of said brake-application energy reference value is the quotient obtained by dividing said brake-application energy reference value by said stored non-current brake-application energy reference value.

12. The method according to claim 11, wherein said set brake-application energy value for said tractor vehicle is the product obtained by multiplying said set deceleration value by said brake-application energy level for said tractor vehicle and by said value that is a function of said brake-application energy reference value.

13. The method according to claim 11, wherein said set brake-application energy value for said trailer vehicle is the product obtained by multiplying said set deceleration value by said brake-application energy level for said trailer vehicle and by said value that is a function of said brake-application energy reference value.

14. The method according to claim 1, further comprising the steps of measuring a wheel brake ratio and a static pressure ratio, and wherein said axle-load ratio is the product obtained by multiplying said wheel brake ratio and said static pressure ratio.

15. The method according to claim 14, further comprising the steps of measuring a braking force value for said at least one front axle of said tractor vehicle and a braking force value for said at least one rear axle of said tractor vehicle, and wherein said wheel brake ratio when said vehicle combination is in an unbraked condition is the quotient obtained by dividing said braking force value for said at least one front axle by said braking force value for said at least one rear axle.

16. The method according to claim 14, wherein said static pressure ratio is determined from a differential slip control function of said electronic braking system.

17. The method according to claim 1, wherein said at least one front axle of said tractor vehicle and said at least one rear axle of said tractor vehicle include axle-load sensors, and wherein said axle-load ratio is determined based on signals of said axle-load sensors.

18. The method according to claim 1, wherein said at least one rear axle of said tractor vehicle has at least one axle-load sensor, and said axle-load ratio is determined based on signals of said at least one axle-load sensor.

19. The method according to claim 1, wherein, using said sets of performance characteristics, said brake-application energy level for said tractor vehicle is determined as a function of at least one of said axle-load ratio and said brake-application energy reference value, and said brake-application energy level for said trailer vehicle is determined as a function of one of (i) said brake-application energy reference value and (ii) said brake-application energy reference value and said axle-load ratio.

20. The method according to claim 1, wherein said step of determining said brake-application energy level value for said tractor vehicle and said brake-application energy level value for said trailer vehicle is based on said brake-application energy reference value and said axle-load ratio, said brake-application energy reference value and said axle-load ratio being applied in at least one of linear and affine equations.

21. The method according to claim 1, wherein said set brake-application energy value for said tractor vehicle and said set brake-application energy value for said trailer vehicle are set to zero when said vehicle combination is in an unbraked condition.

22. The method according to claim 1, wherein said step of determining said brake-application energy reference value is based on vehicle dynamics data and the mass of said vehicle combination.

23. The method according to claim 22, wherein said vehicle dynamics data include at least one of engine power and transmission ratio of said vehicle combination.

24. The method according to claim 1, wherein said step of determining said brake-application energy reference value includes filtering said brake-application energy reference value.

25. A method for controlling brake-application energy in a vehicle combination including a tractor vehicle equipped with an electronic braking system and a trailer vehicle, the tractor vehicle having at least one front axle and at least one rear axle, the trailer vehicle having at least one trailer axle, the method comprising the steps of:

determining, during braking of said vehicle combination, a set deceleration value,

measuring, during braking of said vehicle combination, an actual deceleration value,

comparing said set deceleration value with said actual deceleration value,

determining a brake-application energy reference value from the comparison of said set deceleration value with said actual deceleration value,

determining a brake-application energy level for said tractor vehicle and a brake-application energy level for said trailer vehicle,

determining an axle-load for said at least one rear axle of said tractor vehicle,

providing sets of performance characteristics in said electronic braking system representing the dependencies of said brake-application energy level for said tractor vehicle and said brake-application energy level for said trailer vehicle on at least one of said brake-application energy reference value and said axle-load of said tractor vehicle,

calculating a set brake-application energy value for said tractor vehicle based on said set deceleration value, a value that is a function of said brake-application

energy reference value, and said brake-application energy level for said tractor vehicle, in accordance with said sets of performance characteristics, and

calculating a set brake-application energy value for said trailer vehicle based on said set deceleration value, said value that is a function of said brake-application energy reference value, and said brake-application energy level for said trailer vehicle, in accordance with said sets of performance characteristics.

26. The method according to claim 25, further comprising the step of distributing brake-application energy to said tractor vehicle and said trailer vehicle based on said set brake-application energy value for said tractor vehicle and said set brake-application energy value for said trailer vehicle.

27. The method according to claim 25, wherein said step of determining said brake-application energy level value for said tractor vehicle and said brake-application energy level value for said trailer vehicle is based on said brake-application energy reference value and said axle-load of said tractor vehicle, said brake-application energy reference value and said axle-load of said tractor vehicle being applied in at least one of linear and affine equations.

28. A system for controlling brake-application energy in a vehicle combination including a tractor vehicle equipped with an electronic braking system and a trailer vehicle, the tractor vehicle having front and rear axles, the trailer vehicle having at least one trailer axle, the system comprising:

means for determining, during braking of said vehicle combination, a set deceleration value,

means for measuring, during braking of said vehicle combination, an actual deceleration value,

means for comparing said set deceleration value with said actual deceleration value,

means for determining a brake-application energy reference value from the comparison of said set deceleration value with said actual deceleration value,

means for determining a brake-application energy level for said tractor vehicle and a brake-application energy level for said trailer vehicle,

means for determining an axle-load ratio for said tractor vehicle,

means for generating sets of performance characteristics in said electronic braking system representing the dependencies of said brake-application energy level for said tractor vehicle and said brake-application energy level for said trailer vehicle on at least one of said brake-application energy reference value and said axle-load ratio,

means for calculating a set brake-application energy value for said tractor vehicle based on said set deceleration value, a value that is a function of said brake-application energy reference value, and said brake-application energy level for said tractor vehicle, in accordance with said sets of performance characteristics,

means for calculating a set brake-application energy value for said trailer vehicle based on said set deceleration value, said value that is a function of said brake-application energy reference value, and said brake-application energy level for said trailer vehicle, in accordance with said sets of performance characteristics, and

means for distributing brake-application energy to said tractor vehicle and said trailer vehicle based on said set brake-application energy value for said tractor vehicle and said set brake-application energy value for said trailer vehicle.

29. A system for controlling brake-application energy in a vehicle combination including a tractor vehicle equipped with an electronic braking system and a trailer vehicle, the tractor vehicle having front and rear axles, the trailer vehicle having at least one trailer axle, the system comprising:

means for determining, during braking of said vehicle combination, a set deceleration value,

means for measuring, during braking of said vehicle combination, an actual deceleration value,

means for comparing said set deceleration value with said actual deceleration value,

means for determining a brake-application energy reference value from the comparison of said set deceleration value with said actual deceleration value,

means for determining a brake-application energy level for said tractor vehicle and a brake-application energy level for said trailer vehicle,

means for determining an axle-load for said rear axle of said tractor vehicle,

means for generating sets of performance characteristics in said electronic braking system representing the dependencies of said brake-application energy level for said tractor vehicle and said brake-application energy level for said trailer vehicle on at least one of said brake-application energy reference value and said axle-load of said tractor vehicle,

means for calculating a set brake-application energy value for said tractor vehicle based on said set deceleration value, a value that is a function of said brake-application energy reference value, and said brake-application energy level for

said tractor vehicle, in accordance with said sets of performance characteristics,

means for calculating a set brake-application energy value for said trailer vehicle based on said set deceleration value, said value that is a function of said brake-application energy reference value, and said brake-application energy level for said trailer vehicle, in accordance with said sets of performance characteristics, and

means for distributing brake-application energy to said tractor vehicle and said trailer vehicle based on said set brake-application energy value for said tractor vehicle and said set brake-application energy value for said trailer vehicle.